Active Project (2016 - 2016)

Fail-Safe, Controllable Liquid Spring/Damper System for Improved Rover Space Vehicle Mobility, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

NASA is planning to return to the moon in 2020 to explore thousands of miles of the moon?s surface with individual missions, lasting six months or longer. Surface mobility is critical to outpost buildup and exploration activities, where the change in the vehicle weight between unloaded and loaded cargo conditions and travel over rough terrain can adversely affect the ride handling conditions and vehicle dynamics. The vehicle suspension system components should accommodate for the required range of vehicle weights and provide mobility during various surface activities. In response to NASA?s need to improve surface mobility, an autonomously adaptive liquid spring/damper system is proposed. This system will utilize a compressible fluid, which performs as a liquid spring to eliminate the need for mechanical springs and accumulators, to reduce the overall weight and space requirements of the suspension. The controllable damping force will be utilized by a fluid system that has a fast response time. The system will provide independently controllable damping force on each wheel. Based on our prior work, the proposed system could have a weight saving of more than 20% and size saving of at least 40%. The proposed system is a fail-safe device, i.e., in case of any power interruption or electronic failure, it will retain as a regular passive suspension system component. In this effort, the feasibility of utilizing the proposed system will be demonstrated through testing and multi-body vehicle dynamics model analysis. The proposed system will increase the mobility of the exploration vehicle under different payload (cargo and possible crew) configurations.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: To load, manipulate, deposit and transport payloads to desired sites on the surface of the moon, the suspension systems of prototype NASA robotic

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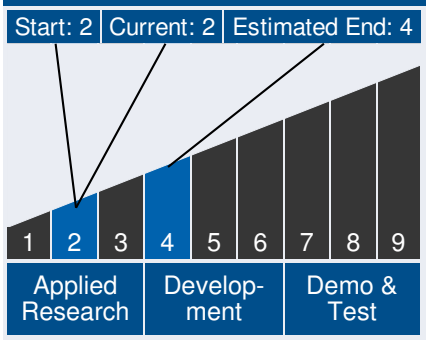
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

vehicles plays a key role. The proposed SBIR Phase I project will demonstrate the feasibility of a liquid spring/damper to be utilized as a component of the active suspension system of NASA's space exploration vehicles, including the Multi-Mission Space Exploration Vehicle (MMSEV) and Chariot and All Terrain Hex-Legged Extra-Terrestrial Explorer (ATHLETE). All vehicles under consideration can support cargo transport and Extra-Vehicular Activity (EVA), which require them to perform activities such as surface navigation, terrain mapping and docking. The proposed system can potentially be utilized in NASA?s Lunar Electric Rover and planetary rovers.

To the commercial space industry:

Potential Non-NASA Commercial Applications: In addition to NASA's applications, advanced controllable suspension systems could be used for vehicle suspension systems, especially for medium/heavy vehicles to reduce weight, increase mobility, enhance controllability of the vehicle's motion, and to prevent rollover in rough terrains and during emergency maneuvers. The applications range from commercial and private sector to military, such as medium/heavy commercial vehicles, buses, coaches, trailers, High Mobility Multi Wheeled Vehicles (HMMWVs), tracked vehicles, unmanned military wheeled vehicles and, Light Armored Vehicles (LAV). The developed liquid spring/damper is also suitable for use in landing system of the airplanes and suspension systems of railway vehicles, such as high-speed trains.

Management Team *(cont.)*

Principal Investigator:
- Barkan Kavlicoglu

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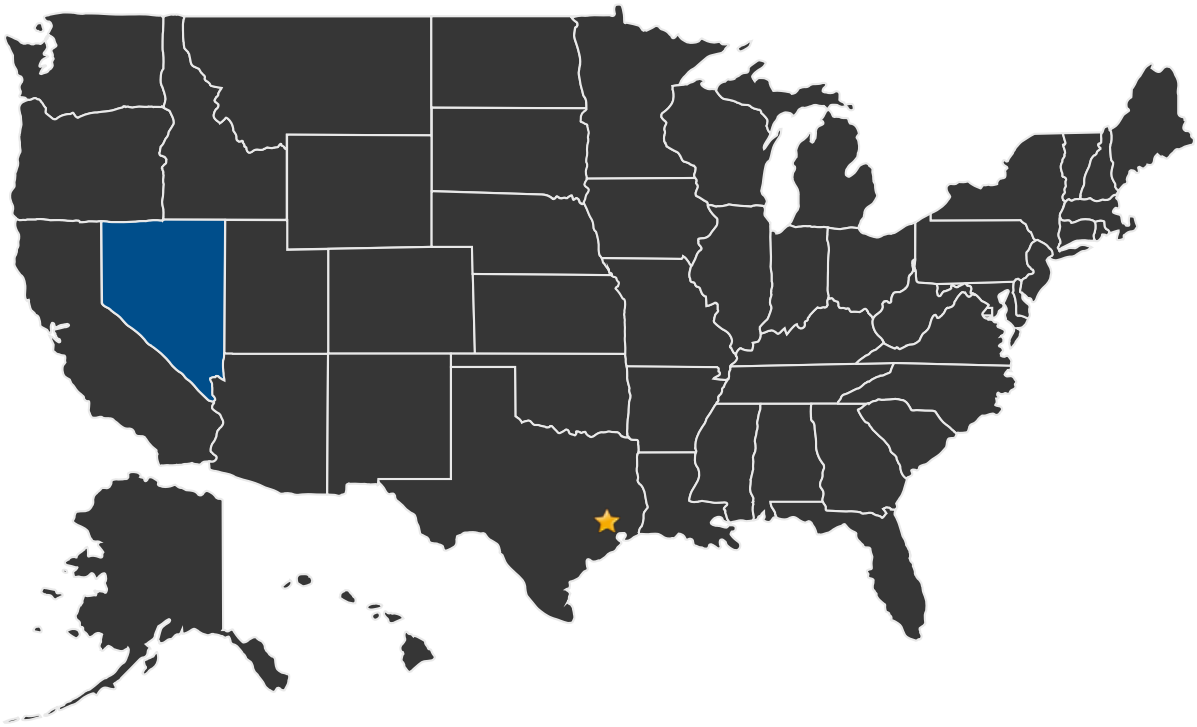
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Johnson Space Center

Other Organizations Performing Work:

- Advanced Materials and Devices, Inc. (Reno, NV)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23252)

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IMAGE GALLERY

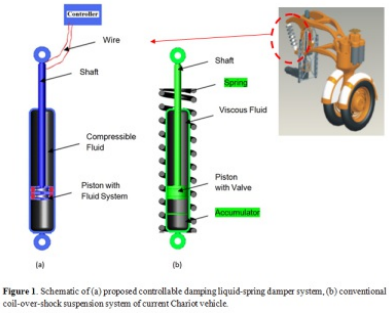

Figure 1. Schematic of (a) proposed controllable damping liquid-spring damper system, (b) conventional coil-over-shock suspension system of current Chariot vehicle.

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DETAILS FOR TECHNOLOGY 1

Technology Title

Fail-Safe, Controllable Liquid Spring/Damper System for Improved Rover Space Vehicle Mobility, Phase I

Potential Applications

To load, manipulate, deposit and transport payloads to desired sites on the surface of the moon, the suspension systems of prototype NASA robotic vehicles plays a key role. The proposed SBIR Phase I project will demonstrate the feasibility of a liquid spring/damper to be utilized as a component of the active suspension system of NASA's space exploration vehicles, including the Multi-Mission Space Exploration Vehicle (MMSEV) and Chariot and All Terrain Hex-Legged Extra-Terrestrial Explorer (ATHLETE). All vehicles under consideration can support cargo transport and Extra-Vehicular Activity (EVA), which require them to perform activities such as surface navigation, terrain mapping and docking. The proposed system can potentially be utilized in NASA?s Lunar Electric Rover and planetary rovers.